Biomass Survey of Rockfish Stocks in the Dixon Entrance–Southeast Alaska Region, July 5–22, 1983 *(R/V G.B. REED* and *M/V FREE ENTERPRISE NO. 1)*

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by

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ABSTRACT

Leaman, B. M. and D. A. Nagtegaal. 1986. Biomass survey of rockfish stocks in the Dixon Entrance - southeast Alaska region, July 5-22, 1983. (R/V G.B. REED and M/V FREE ENTERPRISE NO. 1). Can. Tech. Rep. Fish. Aquat. Sci. 1510: 63 p.

Two vessels were used to survey rockfish aggregations on the outer continental shelf (180-640 m) between 54°10'N - 55°30'N, using echo sounder and bottom trawl gear. Both stratified-systematic and encounter-response search patterns were employed to detect and map significant aggregations. Rockfish density in the survey area was very low with only two areas showing extensive rockfish echo soundings. One large aggregation (~9 M^2) was observed near 55°10'N and a second area of higher density was detected between 54°10' - 54°25'N. No estimation of the biomass in the northern aggregation was possible due to rough bottom.

Individual schools in the southern area were mapped and sampled. Extrapolation of catch rates over school dimensions suggests a minimum biomass of ~1200 t ± 67%, composed primarily (89%) of Sebastes alutus. Catch rates ranged from 1000-16,000 kg/h. Biomass estimates for comparable areas of a 1979 survey showed both major and minor decreases over the 1979 estimates, depending on area. In addition the commercial fishery has removed approximately four times the total 1983 estimate, during the 1983-1985 period. The value of swept-area surveys for rockfishes is reviewed in light of these results.

Key Words: Rockfishes, trawl surveys, biomass estimates, Dixon Entrance

RESUME

Leaman, B. M. and D. A. Nagtegaal. 1986. Biomass survey of rockfish stocks in the Dixon Entrance - southeast Alaska region, July 5-22, 1983. (R/V G.B. REED and M/V FREE ENTERPRISE NO. 1). Can. Tech. Rep. Fish. Aquat. Sci. 1510: 63 p.

Deux navires ont été utilisés pour effectuer un relevé des bancs de sébastes sur la partie extérieure de la plate-forme continentale (180-640 m) entre 54°10'N et 55°30'N, à l'aide d'un écho-sondeur et d'un chalut de fond. On a utilisé deux régimes de relevé soit un régime systématique stratifié et un régime présence-réaction pour relever et cartographier les bancs importants. Dans la zone étudiée, la densité des sébastes était très faible; seules deux zones montraient des regroupements importants, un (9 m^2) près du 55°10'N et l'autre, de plus grande densité, entre le 54°10'N et le 54°25'N. Il n'a pas été possible d'estimer la biomasse du groupement septentrional à cause du fond accidenté.

Chaque banc de la zone méridionale a été échantillonné et cartographié. L'extrapolation des taux de capture en fonction des dimensions des bancs porte à croire à la présence d'une biomasse minimum d'environ 1 200 t ± 67 % composée en grande partie (89 %) de Sebastes alutus. Les taux de capture variaient de 1 000 à 16 000 kg/h. Des estimations de la biomasse pour des zones comparables étudiées en 1979 révèlent des baisses faibles et importantes par rapport aux estimations de 1979, selon les zones. De plus, les captures commerciales réalisées de 1983 à 1985 s'élèvent à environ quatre fois l'estimation totale de la biomasse en 1983. La valeur des relevés par sondage du sébaste est examinée à la lumière des présents résultats.

Mots-clés: sébastes, relevés par chalutage, estimations de la biomasse, entrée Dixon

INTRODUCTION

Rockfish stocks off the west coast of the Queen Charlotte Islands and north to southeastern Alaska were intensely exploited by Soviet and Japanese fleets during the 1965-1977 period, particularly between 1965-1968 (Table 1). Total removals over the 1965-1977 period are estimated at approximately 82,000 t, with the majority of the catch originating between 54°00' - 54°30'N. While most fishing effort was directed at Pacific ocean perch (Sebastes alutus), we believe that its abundance became so reduced that it was not the major species in the catch after 1972 (Ketchen 1980). Canadian observers reported that S. alutus comprised only 23% of the rockfish catch on Japanese trawlers fishing the Langara Spit area (54°03'-54°20'; Fig. 1) during 1977 (Leaman et al. 1978). The domestic fleet did not begin fishing in this area until 1977 and prior to 1984 the fishery was quite modest (Table 2).

Trawl surveys in the area have been limited. Westrheim (1967) conducted exploratory fishing off southeastern Alaska and Langara Spit and found 78-96% of the rockfish catch was S. alutus during 1965-1966. In 1965 rockfish catch rate (CPUE) was 10,000 kg/h off Forrester Is., but this had dropped to 2300 kg/h by 1966. The CPUE off Langara Spit was 5000 kg/h in 1966 however no substantial rockfish aggregations were encountered during a brief survey in 1971 (Westrheim 1972). In 1979 a two-boat trawl survey of rockfishes in the Langara Spit area estimated a biomass of 3000-5000 t of marketable species of which ~53% was S. alutus (Lapi and Richards 1981). Ketchen et al. (1978) estimated that the rockfish biomass in this area, prior to 1965, may have been as high as 105,000 t.

As a component of a comprehensive management program it was proposed in 1983 that the Langara Spit area be designated as an experimental open-fishing area for a specified period (Leaman 1985). The objectives of the experiment were to examine the validity of the existing biomass estimate and to determine if the evidently weak stock-recruitment relationship of S. alutus (Archibald et al. 1983) might become more manifest below some threshold abundance level. To conduct this experiment it was necessary to collect baseline biological and abundance data from both sides of the provisional Canada - United States boundary, in the event there might be transboundary stock(s) movement during the course of the experiment. This report presents the results of a two-vessel survey of the Dixon Entrance - southeast Alaska region to collect such information. Preliminary data analysis and biomass calculations are also included.

VESSELS AND GEAR

The survey was conducted by two vessels, the side-trawler R/V G.B. REED (GBR) and the chartered Canadian stern-trawler M/V FREE ENTERPRISE NO. 1 (FE). Detailed vessel specifications are contained in Appendix tables 1 and 2. The GBR fished with an Atlantic Western III trawl and the FE with an Atlantic Western IIIa, both of which were rigged for hard-bottom trawling.

Net specifications are presented in Appendix Figures 1 and 2, respectively. The GBR was equipped with a SIMRAD EK 38 wet-paper sounder, while the FE used a dry-paper, SIMRAD EQ; both vessels also used LORAN-C plotters.

SURVEY DESIGN AND SAMPLING METHODS

The Langara Spit and Canada - U.S. boundary areas were the primary targets for the survey but effort was expended as far north as Cape Addington (55°30'N). Based on review of previous survey activity, the area between the 219-365 m (120-200 f) isobaths received the most intensive coverage.

Our survey design employed two search patterns: a stratified, systematic component and an encounter-response component. The systematic design used both depth and latitudinal strata; depth strata were 55 m (30 f) and latitudinal strata were either two or five M (nautical mile) spacing of trackline. Higher trackline densities coincided with areas of fish abundance identified in previous surveys and a total of 57 tracklines resulted (Fig. 1). Tracklines were searched with a zig-zag pattern, beginning at one depth limit of a stratum, 0.5 M from the trackline, and extending across the trackline to 0.5 M on the opposite side, at the other depth limit of the stratum. At the end of each trackline, the vessel searched in a diagonal course to the opposite-depth end of the next trackline.

The encounter-response component was used only when rockfish aggregations were encountered. Each aggregation whose dimensions were at least 0.5 M in one direction was mapped, to obtain total area, and subsampled systematically to estimate fish density in the aggregation. We have been examining the potential of this technique (Leaman 1981) as an alternate (minimum estimate) to traditional surveys.

Aboard the GBR the entire catch was sorted and weighed by species (Westrheim 1967). Aboard the FE the catch for hauls of <0.5 t was sampled as on the GBR, but for hauls >0.5 t the codend was fleeted aboard and weighed with an electronic load cell[1], emptied and reweighed to obtain the catch weight by difference. The catch was then subsampled to obtain the species composition by weight. Subsampling, when necessary, was accomplished by removing fish from the beginning, middle and end of the codend. Biological samples were extracted in the same way.

A minimum of 200 length/sex/maturity/double otolith measurements were obtained from each major aggregation of S. alutus. Ovaries from S. alutus in the Langara Spit area were also obtained as part of an ongoing reproductive biology project; ovaries were fixed in either Smith's formal dichromate for histological study or Gilson's (1910) fluid for oocyte counts and measurements. In addition some S. alutus were sampled for presence and infection rate of the copepod gill parasite Neobrachiella robusta.

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[1]SEA WEIGH, Measurement Systems Incorporated, Seattle, WA.

Expendable bathythermographs (XBTs) were deployed by the GBR at standard stations in the survey area, as well as in Hecate Strait and Queen Charlotte Sound.

BIOMASS ESTIMATION

Biomass estimates were calculated using a modified version of Westrheim et al.'s (1972) swept-area algorithm:

$$B_T = \sum_{s=1}^{N} \left(\frac{\overline{CPUEs}}{k_a} \right) (A_s)\ (c) \qquad \text{where}$$

B_T = estimated total biomass in strata or school (t)

N = number of hauls or strata

$\overline{CPUEs}$ = mean catch per hour trawled in stratum/school (t/h)

k_a = area of bottom trawled in one h (M^2)

A_s = total area of stratum/school (M^2)

c = catching coefficient of trawl gear

Rockfish biomass was the sum of the individual species estimates for each stratum or school. The catching coefficient (c) was assumed to be 1.0 as outlined in Leaman and Nagtegaal (1982). K_a was the product of vessel speed and effective path width of the trawl net. The latter quantity was taken as the distance between the trawl doors and was calculated using Carrother's (1980) analytical method. This method uses trawl construction data, i.e. lengths of headline, footrope and bridle/sweeps, wing spread, and catenary parameter to estimate horizontal opening. The wingspread estimate was derived from empirical measurements of nets similar to Atlantic Western III trawls made by the U.S. National Marine Fisheries Service (Anon. 1978). Using this procedure gave an estimate of door spread very similar to that presented by Carrothers (1980) for the same net. The door spread estimate for the GBR was larger than for the FE due to the longer sweeplines in the former (Table 3).

The area of rockfish schools for encounter-response sampling was calculated by computer digitizing of LORAN plotter sheets, scaled for vessel speed.

Confidence limits for the biomass estimates were calculated as follows:

$$B_T \pm t_{(.95,\, n_e)} S.E._{\overline{CPUEs}}$$

$$\text{where} \quad S.E._{\overline{CPUEs}} = \sqrt{\frac{(\Sigma CPUE^2 - (\Sigma CPUE)^2/n)}{n-1}} \Big/ \sqrt{n}$$

and n_e, the effective degrees of freedom is from Satterthwaite (1946):

$$n_e = \frac{\left(\sum_{i=1}^{n} s_i^2 \right)^2}{\sum_{i=1}^{n} \left(\frac{s_i^4}{n_i - 1} \right)}$$

RESULTS AND DISCUSSION

General

A total of four hauls by the GBR and 14 by the FE were completed during the survey (Fig. 1). Bridge log and catch data for each vessel are presented in Appendix tables 3 and 4, respectively. A summary of catch weights by major species is presented for the FE in Table 4 and the GBR in Table 5. Sebastes alutus comprised the majority of the catch for both vessels; 87% for the FE and 55% for the GBR.

Biological data were collected only for S. alutus since no major concentrations of other rockfishes were found (Table 6). Table 7 presents the length frequencies for samples taken by the FE in the major aggregations encountered during the survey. Maturity data (classified as in Table 8) for the GBR (Table 9) and FE (Table 10) samples show 70-80% of males were in stage 2 (maturing) while females were either maturing or resting (stage 7); very few juveniles (<25 cm) were encountered.

Size frequencies as well as mean round and ovary weights for the histological and fecundity samples are presented in Table 11. The low ovary weights compared with fall samples from this locality (Leaman et al. 1985) reflect the quiescent reproductive state during the summer. Size frequencies of the hosts for parasite samples taken by the GBR and FE are included in Table 12.

Surface temperatures in the major area of study ranged from 13.7-16.7°C while bottom temperatures were less variable, ranging from 4.6-6.3°C (Table 13). Surface temperatures were similar through the coastal region although bottom temperatures at depths <100 m were substantially higher (+6°C) than in deeper water.

Fish Distribution

Distribution and abundance of fish was assessed by both vessels although the GBR concentrated in trackline searching and the FE in the

encounter-response design. While the results from the vessels are complementary with regard to fish distribution they will, for the purpose of this report, be presented separately.

The GBR encountered mainly isolated, small schools in the northern survey area, with most occurring between 183-275 m (100-150 f) and very little sign at other depths (Fig. 2). A consistent, though sparse, sign was observed between 238-247 m (130-135 f) on each of tracklines 11-20, suggesting a widely dispersed, but continuous school along these isobaths. The single, large school encountered on trackline 9 covered an area 3.4x6.0 M but was over untrawlable bottom.

Considerably more sign of fish was observed by the GBR in the Langara Spit area, particularly between 183-275 m on tracklines 23-38 and in the same depths on tracklines 35-37. Two hauls (2, 3) were completed on the west side of the Spit and the catches consisted of approximately 60% S. alutus, 14% S. reedi and 12% S. zacentrus (Appendix Table 3). Catches averaged approximately 2700 kg/h (~6000 lb/h) for these two hauls. Very little fish sign was observed in the Learmonth Bank area (tracklines 38 and 39).

The pattern of fish distribution noted by the FE in the northern survey area was very similar to that of the GBR (Fig. 3), although a slightly larger body of fish was noted by the FE between tracklines 8-10, particularly on line 10 between 200-220 m (110-120 f). Elsewhere (north of 54°30'), only isolated small schools were noted. A single tow (Fig. 1) was made in this northern area, at a site occupied by the GBR during a 1965 exploratory cruise. At that time the catch rate was ~11,000 kg/h (25,000 lb/h), however the catch rate in 1983 was only 800 kg/h (1770 lb/h) and consisted of 43% S. alutus.

South of 54°30' the FE identified the same areas of higher abundance noted by the GBR although the isobath searching pattern of the FE showed a large, continuous school between tracklines 26-28, as well as similar densities around tracklines 23 and 25. Eight hauls (Fig. 1) were made on these concentrations with catch rates averaging 7864 kg/h (17,300 lb/h) and composed of 89% S. alutus (Appendix table 4). Three hauls were completed on the concentrations noted on tracklines 36 and 37 although catch rates were much lower, 1049 kg/h (2313 lb/h), and the proportion of other species in the catch was higher (73% alutus).

The areas of rockfish schools sufficiently large for accurate calculation within the operating characteristics of the vessels are presented in Table 14.

CATCH RATES AND BIOMASS ESTIMATES

Catch rates by school and haul are listed for the GBR and FE in Tables 15 and 16, respectively and illustrate the large variation normally encountered among different rockfish aggregations. However, this variation

(±65-75%) is considerably lower than that experienced in the usual stratified-random rockfish survey (±100-150%, e.g. Gunderson and Sample 1980). Catch rate (kg/h) variation, as a percentage of the grand mean, among schools was 99.6% for the GBR and 102.4% for the FE. Only the FE conducted repetitive sampling within schools and the comparable statistics to the among school variates ranged from 33.9-65.0%. The maximum catch rate for S. alutus (15,087 kg/h) occurred on the western edge of Langara Spit.

Biomass estimates were calculated only for those schools which were mapped and sampled. Figures 2 and 3 illustrate both those schools encountered (cross-hatching) and those which were sampled (stippling), for each vessel. Fewer schools were sampled by the GBR due both to the greater precision of fishing by the FE and to allow the GBR to concentrate on searching.

Estimated biomass for schools identified by the GBR are listed in Table 17 and those from the FE in Table 18. Sebastes alutus comprised the majority of the total biomass estimate for both vessels. Although we present the estimates for the GBR they are clearly insufficient for inferences about the entire Langara Spit area. However, if one chooses to accept an assumption of equivalent, mean catch rates between sampled and unsampled schools then a point estimate for the biomass of all rockfish schools in the Langara Spit area is 555 t (Table 19). While a similar procedure could be used to generate a confidence interval for such an estimate, it would clearly be unrealistic to do so. A biomass estimate for mapped schools of the entire survey area is 1191 t.

Biomass estimates for those aggregations sampled by the FE (Table 18) show similar confidence intervals for the major species (S. alutus), although those for minor species vary substantially. A confidence interval for the total biomass in all sampled schools is more difficult to estimate due to the single samples from schools A-C. If an assumption of similar variance within schools is made then the confidence interval for the S. alutus total would be about 1184 t ± 67%. These estimates refer only to the sampled schools and must be regarded as minimum estimates of the total biomass in the Langara Spit area.

COMPARISON WITH 1979 SURVEY ESTIMATES

The report of the 1979 two-boat survey of the Langara Spit area (Lapi and Richards 1981) did not present biomass estimates but the authors did calculate such estimates by subsection of the survey area (Fig. 4). Lapi and Richards used a catching coefficient of c=0.67 for the area swept between the trawl doors, based on acoustic transponder work for gadids and pleuronectids (Harden-Jones et al. 1977). We have used c=1.0 for the same path width, when surveying rockfishes, because videotape evidence suggests these other species are less sensitive to the approaching trawl gear than scorpaeniform fish, and because we would prefer to err on the conservative side in our methodology. Elsewhere, we have commented in more detail on this topic (Leaman and Nagtegaal 1982). The consequence of the difference in c is that the 1979

estimates must be multiplied by 1.49 for direct comparison with the present estimates. Tables 20 and 21 present these estimates for the 1979 survey vessels.

The present estimates are not strictly comparable to the 1979 estimates because we calculate biomass of sampled aggregations whereas the 1979 estimates refer to areas, which were sampled systematically. Nonetheless, we can make general comparisons between the FE estimates for aggregations C and D and the 1979 area A, and for FE aggregation E and the 1979 area D. Table 22 presents these comparisons and also an estimate for the areas A and D of Lapi and Richards, if our 1983 catch rates were used to calculate biomass by area. The 1983 estimates are lower than those of 1979 for the western Langara Spit area; by 43% for S. alutus on the basis of catch rate extrapolations but only by 12% on the basis of aggregation estimates. However, for the eastern Langara Spit (1979 area D, FE area E) the 1983 estimates are substantially (90+%) below the estimates of the SCOTIA BAY for S. alutus, S. reedi, S. variegatus and S. zacentrus, although similar to the BLUE WATERS estimate for S. alutus. Although there are differences in the timing of the surveys, gear used and effort expended, both surveys identified the same areas of rockfish abundance. We do not believe the 1983 survey achieved adequate sampling of the eastern Langara Spit area, or at least sampling comparable to that for the western Spit. Hence, our biomass estimate for this eastern area is conservative.

COMPARISON WITH COMMERCIAL LANDINGS

It is not possible to conduct a detailed comparison of biomass estimates for the sub-areas of Langara Spit and commercial fishery data due to the confidentiality of locality-specific information in the latter. However, Table 2 illustrates that the biomass estimate for S. alutus derived from the 1979 survey data is approximately five times that of the commercial landings over the 1981-83 period, although that for S. aleutianus is only slightly greater than landings. The fishery was restricted by annual quotas from 1981-1983.

Table 2 also shows that the fishery has removed approximately four times the estimated 1983 biomass of S. alutus in the Langara Spit area, since fishery restrictions were removed in 1984. However, there has been a general decline in the catch rate for the fishery since 1981, and the species composition has shifted from 38% S. alutus in 1981 to 71% in 1984. Additionally, the fishery has produced major reductions in the number of larger fish in the S. alutus stock. Prior to this fishery 44% of the fish were $\geq$ 40 cm but less than 8% of the fish were $\geq$ 40 cm by 1986.

Validity of Biomass Survey Estimates

We have become increasingly dissatisfied with biomass surveys for rockfishes over the past half decade (Leaman 1981; Leaman and Nagtegaal 1982). This dissatisfaction stems not only from the poor precision of the estimators, where confidence intervals equal to several times the value of the estimate are not uncommon, but from a growing conviction that even the point

estimates may be grossly in error. While some authors (e.g. Lenarz and Adams 1980) have attempted to examine and minimize the imprecision of the estimators, studies using alternate techniques to estimate stock biomass (e.g. Archibald et al. 1983, Leaman 1985) indicate that trawl surveys generally mis-estimate absolute rockfish biomass, often by a substantial amount.

The development of the encounter-response survey design (Leaman 1981) was an attempt to diminish the problems of imprecision in survey estimates by tailoring the survey to the biological characteristics of the target species. While we cannot dismiss the possibility of immigration, comparison of the 1979 and 1983 surveys of the Langara Spit area with the results of the commercial fishery argues convincingly that the 1983 survey also falls short of the goal of providing a reliable absolute estimator of biomass. We hasten to add that other designs appear to perform even more poorly. In part, this poor performance is due to the inability of all existing designs to deal with repetitive sampling of the same aggregation, and the response of the aggregation to the sampling gear. For example, during the 1983 survey we found very high and similar catch rates at each slack period of the tidal cycle, yet the traditional stratified random survey affords no means of assessing either how long they would persist or how catches and distributions during these periods relate to those during other periods of the tidal cycle. Answering these questions would appear to require an integration of the spatial and temporal dynamics of the aggregations, with a sampling effort sufficiently intense to generate a quantitative response in the aggregations. Clearly, this type of investigation will have to be performed outside the framework of a biomass survey and may benefit from the inclusion of hydro-acoustic monitoring of the behaviour of aggregations.

We find these results disturbing. Agencies presently spend hundreds of thousands of dollars assessing rockfish biomass, yet it appears that existing survey designs may fall well short of providing reliable absolute estimates of rockfish biomass. It is also apparent that other indices of stock status (size and numbers at age, commercial catch statistics) and analytic methods (catch-at-age analysis) provide more accurate and reliable indices than biomass surveys. Given these shortcomings it may be futile to continue such surveys until substantive improvements in their design and execution can be achieved, if they are the sole measure of absolute abundance. Trawl surveys may still provide useful relative indices if they are conducted consistently over a long (10-15 yr) period.

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Table 1. Reported "Pacific ocean perch" production off the west coast of the Queen Charlotte Islands (PMFC Area 5E). Catches in tonnes and CPUE in tonnes/hr.

Year	USSR[a]	Japan	Total	Japan CPUE
1964	-	-	-	-
1965	24,740	-	24,740	-
1966	15,896	300	16,196	4.17
1967	2,847	5,216	8,163	3.71
1968	1,054	8,042	9,096	2.57
1969	159	4,169	4,328	2.46
1970	-	1,894	1,671	2.12
1971	-	3,033	3,033	2.62
1972	-	4,469	4,469	2.95
1973	-	3,514	3,514	2.40
1974	-	2,442	2,442	1.73
1975	-	1,833	1,833	1.11
1976	-	1,992	1,992	1.20
1977	-	1,270	1,270	0.91

[a]All USSR statistics are estimated from surveillance.

Table 2. Commercial fishery statistics for Langara Spit area, 1981-1985 (interviewed).

	1981		1982		1983		1984		1985[a]	
	L[b]	L/E[c]	L	L/E	L	L/E	L	L/E	L	L/E
S. aleutianus	98.08	3.77	69.09	.93	84.01	.31	208.62	.25	447.75	.33
S. alutus	63.58	1.96	218.48	1.52	226.43	.56	1832.45	1.50	1825.63	.96
S. babcocki	1.12	.23	4.56	.08	.90	.05	2.86	.02	2.26	.02
S. borealis	.09	.02	.85	.02	2.53	.01	6.87	.01	7.02	.01
S. brevispinis	2.26	.23	29.53	.53	10.62	.09	233.15	.31	243.04	.19
S. crameri	-	-	10.16	.31	2.86	.72	7.32	.24	10.93	.09
S. diploproa	-	-	-	-	-	-	7.17	.05	2.30	.05
S. entomelas	-	-	46.00	1.70	.87	.14	.70	.01	3.80	.05
S. flavidus	-	-	-	-	-	-	.67	.03	-	-
S. pinniger	-	-	-	-	-	-	4.34	.06	3.66	.03
S. proriger	.33	.07	6.43	.18	3.14	.18	108.31	.19	259.71	.22
S. reedi	2.34	.48	54.58	.78	18.36	.41	63.05	.13	173.11	.17
S. variegatus	-	-	-	-	-	-	2.25	.08	.75	.04
S. zacentrus	-	-	5.73	.17	8.06	.42	37.15	.09	16.49	.06
Total[d]	167.87	1.64	451.58	.61	393.00	.25	2514.91	.48	2996.46	.36

[a]Preliminary data.

[b]Interviewed landings (tonnes).

[c]Landings per unit effort (tonnes/hr).

[d]Includes unidentified rockfish catch.

Table 3. Net characteristics and estimated trawl door spread for gear used in the 1983 survey.

HS wing spread	HL headline length	FL footrope length	SL wing bridle length	SG sweep length	AW Catenary parameter	DS estimated door spread	SAD[a] swept area (1 hr)
ATLANTIC WESTERN IIIA (FREE ENTERPRISE NO. 1)							
50.0	83.5	121.0	90.0	30.0	800.0	139.0	.0685920
ATLANTIC WESTERN III (G.B. REED)							
50.0	79.0	112.0	120.0	30.0	800.0	170.8	.0842774

[a]Based on vessel speed of 3.0 knots.

Table 4. Summary of total catch, M/V FREE ENTERPRISE NO. 1.

Species	Weight (kg)	Percent
S. alutus	39,726	87
S. brevispinis	893	2
S. entomelas	897	2
S. proriger	532	1
S. reedi	703	2
S. zacentrus	2288	5
Other[a]	648	1
Total	45,687	100

[a]Those species comprising <1% of the total catch.

Table 5. Summary of total catch, R/V G.B. REED.

Species	Weight (kg)	Percent
S. alutus	3,638	55
S. brevispinis	536	8
S. proriger	492	7
S. reedi	878	13
S. zacentrus	938	14
Other[a]	86	3
Total	6,568	100

[a]Those species comprising <1% of the total catch.

Table 6. Biological sampling summary.

Vessel	Species	Sample type	No. collected
FREE ENTERPRISE NO. 1	S. alutus	Len/sex/mat/d-oto	775
	" "	Len/sex/mat/d-oto/gill raker	38
	" "	Len/sex/mat/d-oto/ovary	99
G.B. REED	" "	Len/sex/mat/d-oto	400
	" "	Len/sex/mat/d-oto/gill raker	70

Table 7. Length-sex frequency of S. alutus by haul from the west Langara Spit area during July, 1983. Hauls are separated by vessel--FREE ENTERPRISE NO. 1 (FE), G.B. REED (GBR).

Area:	Langara Spit (outside)														
Date:	11/7/83			11/7/83			12/7/83			14/7/83					
Haul:	FE-2			FE-4			FE-5			FE-8			Total		
Length (cm)	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1
24	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1
25	-	-	-	-	-	-	-	-	-	-	0	0	-	0	0
26	-	-	-	-	-	-	-	-	-	4	2	6	4	2	6
27	-	-	-	-	-	-	-	-	-	2	2	4	2	2	4
28	-	-	-	-	-	-	-	-	-	4	0	4	4	0	4
29	-	-	-	-	-	-	-	-	-	1	1	2	1	1	2
30	1	-	1	-	-	-	-	-	-	1	1	2	2	1	3
31	1	-	1	1	-	1	-	-	-	3	1	4	5	1	6
32	4	1	5	0	-	0	1	-	1	2	3	5	7	4	11
33	2	1	3	0	-	0	1	1	2	5	6	11	8	8	16
34	2	6	8	0	-	0	2	2	4	7	1	8	11	9	20
35	3	0	3	3	1	4	1	0	1	2	0	2	9	1	10
36	5	1	6	7	5	12	10	6	16	3	3	6	25	15	40
37	5	0	5	18	12	30	28	9	37	10	0	10	61	21	82
38	4	3	7	19	13	32	19	16	35	9	2	11	51	34	85
39	3	4	7	27	26	53	20	20	40	15	0	15	65	50	115
40	1	7	8	4	23	27	3	10	13	12	3	15	20	43	63
41	6	23	29	7	13	20	8	17	25	12	4	16	33	57	90
42	1	31	32	-	13	13	2	14	16	11	2	13	14	60	74
43	1	40	41	-	3	3	-	5	5	8	6	14	9	54	63
44	1	32	33	-	5	5	-	3	3	-	6	6	1	46	47
45	-	8	8	-	-	-	-	1	1	-	6	6	-	15	15
46	-	3	3	-	-	-	-	0	0	-	9	9	-	12	12
47	-	-	-	-	-	-	-	1	1	-	1	1	-	2	2
48	-	-	-	-	-	-	-	-	-	-	2	2	-	2	2
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	40	160	200	86	114	200	95	105	200	111	63	174	332	442	774

Table 7 (cont'd).

Area:	Langara Spit (outside)								
Date:	12/7/83			12/7/83					
Haul:	GBR-2			GBR-3			Total		
Length (cm)	M	F	T	M	F	T	M	F	T
30	-	-	-	-	-	-	-	-	-
31	-	-	-	-	1	1	-	1	1
32	1	1	2	-	2	2	1	3	4
33	3	0	3	4	2	6	7	2	9
34	1	1	2	3	1	4	4	2	6
35	4	4	8	6	4	10	10	8	18
36	4	2	6	7	2	9	11	4	15
37	15	3	18	8	0	8	23	3	26
38	18	5	23	24	3	27	42	8	50
39	32	10	42	19	6	25	51	16	67
40	20	11	31	17	9	26	37	20	57
41	11	17	28	5	14	19	16	31	47
42	1	9	10	2	18	20	3	27	30
43	2	10	12	2	19	21	4	29	33
44	1	8	9	-	15	15	1	23	24
45	-	6	6	-	3	3	-	9	9
46	-	-	-	-	1	1	-	1	1
47	-	-	-	-	2	2	-	2	2
48	-	-	-	-	1	1	-	1	1
49	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-
Total	113	87	200	97	103	200	210	190	400

Table 8. Description of rockfish maturity stages.

Maturity code			Gonad condition
Females:	1	Immature	(translucent, small)
	2	Maturing--small	(small yellow eggs; translucent or opaque)
	3	Maturing--large	(large yellow eggs; opaque)
	4	Mature	(large orange-yellow eggs; translucent)
	5	Embryos or larvae	(includes eyed eggs)
	6	Spent	(Large flaccid red ovaries. A few larvae may be present)
	7	Resting	(moderate size, firm, red-grey ovaries)
Males:	1	Immature	(translucent, stringlike)
	2	Maturing	(swelling, brown-white)
	4	Mature	(large, white; easily broken)
	5	Ripe	(running sperm)
	6	Spent	(flaccid, red)
	7	Resting	(ribbon-like; small, brown)

Table 9. Summary of maturity data collected by haul, R/V G.B. REED.

GBR 83-1
Species: S. alutus
Locality: Langara Spit (outside)
Date: July 12, 1983.
Haul: 2
Depth (m): 238

	Male						Female						
CONDITION:	1	7	2	4	5	6	1	2	3	4	5	6	7
LENGTH (cm)													
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	1	-	-	-	1	-	-	-	-	-	-
33	1	1	1	-	-	-	-	-	-	-	-	-	-
34	1	0	0	-	-	-	-	1	-	-	-	-	-
35	2	0	2	-	-	-	-	2	-	-	-	-	2
36	0	0	4	-	-	-	-	2	-	-	-	-	0
37	3	0	12	-	-	-	-	2	-	-	-	-	1
38	0	0	18	-	-	-	-	3	-	-	-	-	2
39	2	1	29	-	-	-	-	4	-	-	-	-	6
40	-	0	19	-	-	-	-	4	-	-	-	-	7
41	-	0	11	-	-	-	-	6	-	-	-	-	11
42	-	0	1	-	-	-	-	6	-	-	-	-	3
43	-	1	1	-	-	-	-	2	-	-	-	-	8
44	-	-	1	-	-	-	-	1	-	-	-	-	7
45	-	-	-	-	-	-	-	2	-	-	-	-	4
46	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	10	3	100				1	35					51
% Maturity	9	3	88				1	40					59
Total:			113							87			
Sex ratio:			56%							44%			

Table 9 (Cont'd)

GBR 83-1
Species: S. alutus
Locality: Langara Spit (outside)
Date: July 12, 1983.
Haul: 3
Depth (m): 280

	Male						Female						
CONDITION:	1	7	2	4	5	6	1	2	3	4	5	6	7
LENGTH (cm)													
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	1	-	-	-	-	-	-
32	-	-	-	-	-	-	2	-	-	-	-	-	-
33	4	-	-	-	-	-	1	1	-	-	-	-	-
34	1	-	2	-	-	-	0	1	-	-	-	-	-
35	2	-	4	-	-	-	3	1	-	-	-	-	-
36	3	-	4	-	-	-	-	2	-	-	-	-	-
37	2	-	6	-	-	-	-	0	-	-	-	-	-
38	-	-	24	-	-	-	-	1	-	-	-	-	2
39	-	-	19	-	-	-	-	3	-	-	-	-	3
40	-	-	17	-	-	-	-	4	-	-	-	-	5
41	-	-	5	-	-	-	-	5	-	-	-	-	9
42	-	-	2	-	-	-	-	9	-	-	-	-	9
43	-	-	2	-	-	-	-	9	-	-	-	-	10
44	-	-	-	-	-	-	-	5	-	-	-	-	10
45	-	-	-	-	-	-	-	2	-	-	-	-	1
46	-	-	-	-	-	-	-	1	-	-	-	-	0
47	-	-	-	-	-	-	-	2	-	-	-	-	0
48	-	-	-	-	-	-	-	-	-	-	-	-	1
49	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	12		85				7	46					50
% Maturity	12		88				7	45					48
Total:			97							103			
Sex ratio:			49%							51%			

Table 10. Summary of maturity data collected by haul, M/V FREE ENTERPRISE NO. 1.

FE 83-1
Species: S. alutus
Locality: Langara Spit (outside)
Date: July 11, 1983.
Haul: 2
Depth (m): 238

	Male						Female						
CONDITION:	1	7	2	4	5	6	1	2	3	4	5	6	7
LENGTH (cm)													
30	-	-	1	-	-	-	-	-	-	-	-	-	-
31	1	-	0	-	-	-	-	-	-	-	-	-	-
32	4	-	0	-	-	-	-	1	-	-	-	-	-
33	1	-	1	-	-	-	-	1	-	-	-	-	-
34	-	-	2	-	-	-	-	5	-	-	-	-	1
35	-	-	3	-	-	-	-	0	-	-	-	-	0
36	-	-	5	-	-	-	-	1	-	-	-	-	0
37	-	-	5	-	-	-	-	0	-	-	-	-	0
38	-	1	3	-	-	-	-	2	-	-	-	-	1
39	-	2	1	-	-	-	-	1	-	-	-	-	3
40	-	0	1	-	-	-	-	1	-	-	-	-	6
41	-	2	4	-	-	-	-	4	-	-	-	-	19
42	-	1	-	-	-	-	-	4	-	-	-	-	27
43	-	1	-	-	-	-	-	7	-	-	-	-	33
44	-	1	-	-	-	-	-	4	-	-	-	-	28
45	-	-	-	-	-	-	-	-	-	-	-	-	8
46	-	-	-	-	-	-	-	-	-	-	-	-	3
47	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	6	8	26					31					129
% Maturity	15	20	65					20					80
Total:			40							160			
Sex ratio:			20%							80%			

Table 10 (cont'd)

FE 83-1
Species: S. alutus
Locality: Langara Spit (outside)
Date: July 11, 1983.
Haul: 4
Depth (m): 238

	Male						Female						
CONDITION:	1	7	2	4	5	6	1	2	3	4	5	6	7
LENGTH (cm)													
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	1	-	-	-	-	-	-	-	-	-	-	-	-
32	0	-	-	-	-	-	-	-	-	-	-	-	-
33	0	-	-	-	-	-	-	-	-	-	-	-	-
34	0	-	-	-	-	-	-	-	-	-	-	-	-
35	1	-	2	-	-	-	-	1	-	-	-	-	-
36	-	1	6	-	-	-	-	2	3	-	-	-	-
37	-	2	16	-	-	-	-	3	5	-	-	-	4
38	-	5	14	-	-	-	-	1	6	-	-	-	6
39	-	3	24	-	-	-	-	1	13	-	-	-	13
40	-	1	3	-	-	-	-	-	7	-	-	-	16
41	-	5	2	-	-	-	-	-	6	-	-	-	7
42	-	-	-	-	-	-	-	-	2	-	-	-	11
43	-	-	-	-	-	-	-	-	0	-	-	-	3
44	-	-	-	-	-	-	-	-	1	-	-	-	4
45	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	2	17	67					7	43				64
% Maturity	2	20	78					6	38				56
Total:			86							114			
Sex ratio:			43%							57%			

Table 10 (cont'd)

FE 83-1
Species: S. alutus
Locality: Langara Spit (outside)
Date: July 12, 1983.
Haul: 5
Depth (m): 238

	Male						Female						
CONDITION:	1	7	2	4	5	6	1	2	3	4	5	6	7
LENGTH (cm)													
30	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	1	-	-	-	-	-	-	-	-	-	-
33	1	-	0	-	-	-	-	1	-	-	-	-	-
34	-	-	2	-	-	-	-	-	2	-	-	-	-
35	-	-	1	-	-	-	-	-	0	-	-	-	-
36	-	-	10	-	-	-	-	-	2	-	-	-	4
37	-	7	21	-	-	-	-	-	6	-	-	-	3
38	-	7	12	-	-	-	-	-	6	-	-	-	10
39	-	2	18	-	-	-	-	-	8	-	-	-	12
40	-	0	3	-	-	-	-	-	4	-	-	-	6
41	-	1	7	-	-	-	-	-	8	-	-	-	9
42	-	1	1	-	-	-	-	-	6	-	-	-	8
43	-	-	-	-	-	-	-	-	0	-	-	-	5
44	-	-	-	-	-	-	-	-	0	-	-	-	3
45	-	-	-	-	-	-	-	-	1	-	-	-	0
46	-	-	-	-	-	-	-	-	-	-	-	-	0
47	-	-	-	-	-	-	-	-	-	-	-	-	1
48	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	1	18	76					1	43				61
% Maturity	1	19	80					1	41				58
Total:			95							105			
Sex ratio:			48%							52%			

Table 10 (cont'd)

FE 83-1
Species: S. alutus
Locality: Langara Spit (inside)
Date: July 14, 1983.
Haul: 8
Depth (m): 245

	Male						Female						
CONDITION:	1	7	2	4	5	6	1	2	3	4	5	6	7
LENGTH (cm)													
23	-	-	-	-	-	-	1	-	-	-	-	-	-
24	-	-	-	-	-	-	0	1	-	-	-	-	-
25	-	-	-	-	-	-	0	0	-	-	-	-	-
26	4	-	-	-	-	-	2	0	-	-	-	-	-
27	2	-	-	-	-	-	2	0	-	-	-	-	-
28	4	-	-	-	-	-	0	0	-	-	-	-	-
29	1	-	-	-	-	-	1	0	-	-	-	-	-
30	1	-	-	-	-	-	0	1	-	-	-	-	-
31	3	-	-	-	-	-	0	1	-	-	-	-	-
32	2	-	-	-	-	-	1	2	-	-	-	-	-
33	5	-	-	-	-	-	1	5	-	-	-	-	-
34	2	-	5	-	-	-	-	0	1	-	-	-	-
35	0	-	2	-	-	-	-	0	0	-	-	-	-
36	1	1	1	-	-	-	-	1	2	-	-	-	-
37	1	2	7	-	-	-	-	-	0	-	-	-	-
38	-	0	9	-	-	-	-	-	1	-	-	-	1
39	-	0	15	-	-	-	-	-	0	-	-	-	0
40	-	0	12	-	-	-	-	-	2	-	-	-	1
41	-	0	12	-	-	-	-	-	3	-	-	-	1
42	-	1	10	-	-	-	-	-	1	-	-	-	1
43	-	-	8	-	-	-	-	-	1	-	-	-	5
44	-	-	-	-	-	-	-	-	6	-	-	-	0
45	-	-	-	-	-	-	-	-	4	-	-	-	2
46	-	-	-	-	-	-	-	-	5	-	-	-	4
47	-	-	-	-	-	-	-	-	-	-	-	-	1
48	-	-	-	-	-	-	-	-	-	-	-	-	2
49	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	26	4	81				8	11	26				18
% Maturity	24	3	73				13	17	41				29
Total:			111							63			
Sex ratio:			63%							37%			

Table 11. Size frequency and mean ovary weight of S. alutus ovary samples, M/V FREE ENTERPRISE NO. 1.

AREA: Langara Spit (outside)
HAUL: 13 and 14

Length (cm)	Fixative		Mean Rd body wt. (gm)	Mean ovary wt. (gm)
	Smith's	Gilson's		
30	1		405	1.0
31	1	3	412	1.0
32	2	2	449	1.3
33	2	3	493	1.0
34	2	4	439	1.5
35	3	2	594	2.6
36	4	1	672	2.3
37	3	2	684	3.6
38	2	3	736	3.3
39	6	7	784	5.2
40	4	8	902	5.7
41	5	6	932	6.4
42	7	3	1002	7.5
43	5	4	1096	9.0
44	2	1	1099	9.3
45	-	0	-	-
46	-	1	1292	11.0
47	-	-	-	-
48	-	-	-	-
49	-	-	-	-
Total:	49	50		

Table 12. Size frequency of S. alutus gillraker samples, by vessel.

AREA:	G.B. REED Langara Spit (outside)				FREE ENTERPRISE NO. 1 Langara Spit (outside)	
HAUL:	2		3		13 and 14	
Length (cm)	M	F	M	F	M	F
30	-	-	-	1	-	-
31	-	-	-	0	1	1
32	-	1	1	0	3	1
33	2	0	0	1	3	0
34	0	1	2	0	1	2
35	2	1	1	2	3	1
36	2	0	2	6	1	1
37	2	1	3	0	3	0
38	2	2	3	0	2	1
39	2	1	2	1	3	1
40	2	1	1	2	-	3
41	-	2	1	2	-	3
42	-	1	-	2	-	3
43	-	3	-	4	-	0
44	-	2	-	0	-	1
45	-	2	-	1	-	-
46	-	-	-	-	-	-
47	-	-	-	-	-	-
48	-	-	-	-	-	-
49	-	-	-	-	-	-
Total	14	18	16	22	20	18

Table 13. Summary of water temperature data collected, R/V G.B. REED.

Date July/83	Station	Time (PDT)	Latitude	Longitude	Surface (°C)	Bottom (°C)	XBT Depth (m)
06	1	09:21	51°07.0	128°19.9	16.8	6.9	160
"	8	14:00	51°07.0	129°37.0	14.0	6.7	330
"	9	15:40	51°21.0	129°49.0	17.2	6.7	189
"	10	17:08	51°34.9	130°00.0	14.3	6.5	180
"	15	20:15	52°00.1	130°30.0	14.5	5.3	355
"	16	21:24	52°10.0	130°22.0	13.7	5.5	370
"	17	22:25	52°20.0	130°15.0	16.5	5.4	310
"	18	23:27	52°30.0	130°07.0	16.4	5.5	280
07	19	00:42	52°40.0	130°09.0	16.6	5.5	235
"	20	01:38	52°50.0	130°10.5	16.7	5.6	240
"	21	02:43	53°00.0	130°12.0	16.7	5.7	208
"	22	04:13	53°09.0	130°27.5	16.6	6.3	188
"	23	05:45	53°20.0	130°45.5	13.5	6.7	160
"	27	09:17	53°57.0	131°01.0	16.5	10.7	65
"	47	10:55	54°10.0	131°13.0	16.6	12.0	46
"	33	12:33	54°24.5	131°15.0	16.6	6.7	145
08	T-1	09:30	55°26.9	134°55.5	16.3	4.9	385
"	T-3	13:15	55°19.5	134°40.7	14.7	4.9	435
"	T-6	19:50	55°15.3	134°19.5	13.9	4.8	445
09	T-9	12:47	55°09.2	134°13.4	13.8	5.0	403
"	T-13	18:10	54°29.9	134°18.1	14.0	5.1	390
10	T-15	12:28	54°44.9	134°10.5	13.7	5.0	408
"	T-17	14:48	54°39.2	134°05.3	14.2	6.2	255
"	T-18	16:00	54°35.6	134°03.3	14.0	5.2	430
"	T-20	20:10	54°29.9	134°00.7	14.0	5.0	450
11	T-22	14:38	54°26.7	133°52.3	14.0	5.0	430
12	T-26	14:15	54°14.1	133°49.2	16.6	5.4	380
"	T-28	21:52	54°09.0	133°42.5	16.7	4.6	422
13	T-32	13:35	54°11.0	133°30.8	16.7	5.6	370
"	T-33	19:12	54°14.3	133°31.4	16.6	5.5	350
14	T-39	22:39	54°29.6	133°16.5	16.6	6.1	270
15	X-1	00:55	54°18.5	133°25.0	16.7	5.5	416
"	T-40	10:39	53°57.7	133°31.2	16.6	5.3	327
"	T-44	20:36	54°09.4	133°22.1	16.6	5.3	350
16	T-47	19:48	54°12.8	133°18.7	16.6	5.5	440
17	X-2	16:12	54°21.1	133°25.2	16.6	5.5	450
20	H8	06:30	54°10.0	131°29.0	16.6	12.7	40
"	33	09:15	53°41.5	133°13.0	16.6	13.0	40
"	41	11:50	53°12.5	131°12.5	16.6	12.0	30
"	23	13:37	53°20.0	130°45.5	16.6	6.5	155
"	22	15:08	53°09.0	130°27.5	16.6	6.2	200
"	21	16:15	53°00.0	130°12.0	16.6	5.5	225
"	20	17:21	52°50.0	130°10.5	17.0	5.5	220
"	19	18:15	52°40.0	130°09.0	16.6	5.4	240
"	18	19:15	53°30.0	130°07.0	16.7	5.4	292
"	13	23:00	52°00.0	129°30.0	16.6	6.2	208
21	5	03:50	51°24.0	128°42.5	16.6	6.2	219
"	1	06:20	51°07.0	128°20.0	16.7	6.8	185

Table 14. Area (M^2) of rockfish schools encountered by the M/V FREE ENTERPRISE NO. 1 and the R/V G.B. REED, July, 1983.

FREE ENTERPRISE NO. 1			G.B. REED		
	Sampled schools	Unsampled schools		Sampled schools	Unsampled schools
A.	.71	26.85	A1.	.51	31.42
B.	.57		B1.	.70	
C.	.80		C1.	.60	
D.	8.92		D1.	1.20	
E.	12.51				

Table 15. Catch rates (kg/hr) by rockfish school and species, R/V G.B. REED.

School Haul	A1 1	B1 2	C1 3	D1 4
S. alutus	12	1435	5586	31
S. babcocki	-	2	53	-
S. brevispinis	86	688	10	66
S. proriger	79	553	-	139
S. reedi	25	1356	-	7
S. zacentrus	316	1047	103	66
Total	518	5081	5752	309

Table 16. Catch rates (kg/hr) by rockfish school and species, M/V FREE ENTERPRISE NO. 1.

School	A	B	C	D							E			
Haul	1	2	3	4	5	6	11	13	14	$\bar{x}$	7	8	10	$\bar{x}$
S. alutus	343	4610	1020	15087	12092	4692	5806	5720	2420	7636± 67%	503	861	902	755± 72%
S. babcocki	99	-	6	-	-	17	21	-	-	6±164%	-	9	7	5±220%
S. brevispinis	7	263	84	124	66	-	-	116	40	58±100%	-	23	12	12±245%
S. entomelas	-	-	-	578	625	40	-	-	9	209±153%	-	-	7	7
S. proriger	159	-	552	262	166	17	21	-	9	79±144%	-	-	-	-
S. reedi	21	1638	102	-	-	-	-	-	-	-	-	25	22	16±216%
S. zacentrus	2	4143	474	-	41	120	200	84	40	81± 93%	-	25	72	32±281%
Total	631	10654	2238	16051	12990	4886	6048	5920	2518	8069± 68%	503	943	1022	822± 84%

Table 17. Biomass estimates[1] (t) of sampled rockfish schools encountered by the R/V G.B. REED (refer to Fig. 2 for school designations).

Species	A1	B1	C1	D1	Total
S. alutus	.1	11.9	39.9	.4	52.3
S. babcocki	-	-	.4	-	.4
S. brevispinis	.5	5.7	.1	.9	7.2
S. proriger	.5	4.6	-	1.9	7.0
S. reedi	.1	11.3	-	.1	11.5
S. zacentrus	1.9	8.7	.7	.9	12.2
Total	3.1	42.2	41.1	4.2	90.6

[1]No confidence limits were calculated since these are point estimates based on only one haul.

Table 18. Biomass estimates (t) of sampled rockfish schools encountered by the M/V FREE ENTERPRISE NO. 1 (refer to Fig. 3 for school designation).

Species	A[1]	B[1]	C[1]	D	E	Total
S. alutus	3.5	38.3	11.9	993.0 ± 66.8%	137.7 ± 72.2%	1184.4
S. babcocki	1.0	-	.1	.8 ± 163.9%	.9 ± 220.1%	2.8
S. brevispinis	.1	2.2	.9	7.5 ± 99.1%	2.1 ± 244.9%	12.8
S. entomelas	-	-	-	27.1 ± 153.4%	.4 ± 430.3%	27.5
S. proriger	1.6	-	6.4	10.3 ± 144.5%	-	18.3
S. reedi	.2	13.6	1.2	-	2.8 ± 216.4%	17.8
S. zacentrus	-	34.4	5.5	10.5 ± 92.8%	5.9 ± 280.8%	56.3
Total	6.4	88.5	26.0	1049.2 ± 68.2%	149.8 ± 84.4%	1319.9

[1]No confidence limits were calculated since these are point estimates based on only one haul.

Table 19. Mean catch rates ($\overline{CPUE}$, kg/hr), school area and biomass estimates for rockfish aggregations encountered and mapped by the R/V G.B. REED, July 1983.

Mean catch rates for sampled schools		Area (M^2) of sampled and unsampled schools	
S. alutus	1766.00		
S. babcocki	13.75		
S. brevispinis	212.50	Total area	= 34.43
S. proriger	192.75	North area	= 18.41
S. reedi	347.00	Langara area	= 16.02
S. zacentrus	383.00		

	Biomass estimates (t)		
	North area[a]	Langara Spit[b]	Total[c]
S. alutus	385.77	335.69	721.47
S. babcocki	3.00	2.61	5.62
S. brevispinis	46.20	40.39	86.81
S. proriger	42.11	36.64	78.74
S. reedi	75.80	65.96	141.76
S. zacentrus	83.66	72.80	156.47
Total	636.34	554.09	1190.87

[a]GBR mean catch rates for sampled schools applied to area of all unsampled schools north of 54°40'N.

[b]GBR mean catch rates for sampled schools applied to area of all sampled and unsampled schools in the Langara Spit area (south of 54°40'N).

[c]GBR mean catch rates for sampled schools applied to area of all sampled and unsampled schools.

Table 20. Biomass estimates (t) by area[a], M/V SCOTIA BAY, 1979.

Species	A	B	C	D	E	F
S. aleutianus[b]	2.19	172.08	29.29	-	222.88	25.47
S. alutus[b]	1142.76	473.89	892.75	1064.27	424.88	156.60
S. babcocki[b]	.69	-	41.37	81.13	46.00	32.11
S. borealis[b]	34.00	63.00	-	-	109.48	93.07
S. brevispinis[b]	13.18	.75	325.70	58.76	15.81	229.98
S. caurinus[b]	-	3.34	-	-	-	-
S. ciliatus[b]	-	-	-	81.41	-	36.25
S. entomelas[b]	-	-	-	-	-	9.51
S. flavidus[b]	-	-	-	-	5.82	-
S. paucispinis[b]	-	-	-	-	-	9.51
S. pinniger[b]	-	-	-	-	12.18	33.13
S. proriger[b]	25.19	-	42.42	142.27	-	33.47
S. reedi[b]	-	-	41.19	923.44	-	-
S. ruberrimus[b]	-	-	.91	74.08	-	-
S. variegatus[b]	1.05	-	-	567.24	-	-
S. zacentrus	25.17	1.82	352.48	1085.74	-	9.51
Seb. alascanus	.22	9.56	125.20	-	92.55	37.06
Total	1244.45	724.44	1851.31	4078.34	929.60	705.67

[a]Calculated using area swept by the doors. Unpublished data (M/V SCOTIA BAY).

[b]Marketable species.

Table 21. Biomass estimates (t) by area[a], M/V BLUE WATERS, 1979.

Species	A	B	C	D	E	F
S. aleutianus[b]	.25	986.13	108.27	1.37	59.73	1.45
S. alutus[b]	205.69	21.42	736.83	206.48	473.79	163.78
S. babcocki[b]	.19	-	3.75	6.30	7.78	30.07
S. borealis[b]	-	116.90	-	-	33.19	2.88
S. brevispinis[b]	15.02	-	156.14	10.20	6.06	116.42
S. ciliatus[b]	-	-	-	2.88	-	-
S. crameri	.91	-	-	-	-	-
S. elongatus	-	-	-	-	-	.61
S. entomelas[b]	-	-	-	-	2.97	.61
S. flavidus[b]	-	-	-	-	-	2.11
S. helvomaculatus	.01	-	10.85	.79	2.93	4.06
S. paucispinis[b]	-	-	-	-	-	14.44
S. pinniger[b]	-	-	-	-	-	144.34
S. proriger[b]	9.96	-	43.92	9.72	3.39	8.55
S. reedi[b]	4.93	-	-	245.34	99.31	1.12
S. ruberrimus[b]	-	-	-	1.93	-	-
S. variegatus[b]	-	-	-	52.00	-	-
S. zacentrus	22.51	-	112.32	137.16	39.86	15.00
Seb. alascanus	.43	42.10	70.45	7.84	203.00	67.27
Total	259.90	1166.55	1242.53	682.01	932.01	572.71

[a]Calculated using area swept by the doors. Unpublished data (M/V BLUE WATERS).

[b]Marketable species.

Table 22. Comparison of biomass estimates (t) between the M/V FREE ENTERPRISE NO. 1 and the 1979 survey, (Lapi and Richards 1981).

Species	C/D[a]	A[b]	SB[c]	BW[d]	E[e]	D[f]	SB[g]	BW[h]
S. alutus	1004.9±62%	656.3±62%	1142.76	205.69	137.7±72%	165.2±72%	1064.27	206.48
S. babcocki	.9±131%	.6±131%	.69	.19	.9±220%	1.2±220%	81.13	6.30
S. brevispinis	8.4±82%	8.8±82%	13.18	15.02	2.1±245%	2.5±245%	58.76	10.20
S. entomelas	27.1±147%	15.9±147%	-	-	.4±430%	.5±430%	-	-
S. proriger	16.7±128%	13.1±128%	25.19	9.96	-	-	142.27	9.72
S. reedi	1.2	22.2	-	4.93	2.8±216%	3.4±216%	923.44	245.34
S. zacentrus	16.0±187%	65.1±187%	25.17	22.51	5.9±281%	7.1±281%	1085.74	137.16
Total	1075.20±68.2%	782.00	1206.99	258.30	149.80±84.4%	179.90	3355.61	615.20

[a]FE estimates for sampled schools C and D.
[b]FE catch rates for sampled schools C and D applied to area A from 1979 survey.
[c]SCOTIA BAY estimates for area A from 1979 survey.
[d]BLUE WATERS estimates for area A from 1979 survey.
[e]FE estimates for sampled school E.
[f]FE catch rates for sampled school E applied to area D from 1979 survey.
[g]SCOTIA BAY estimates for area D from 1979 survey.
[h]BLUE WATERS estimates for area D from 1979 survey.

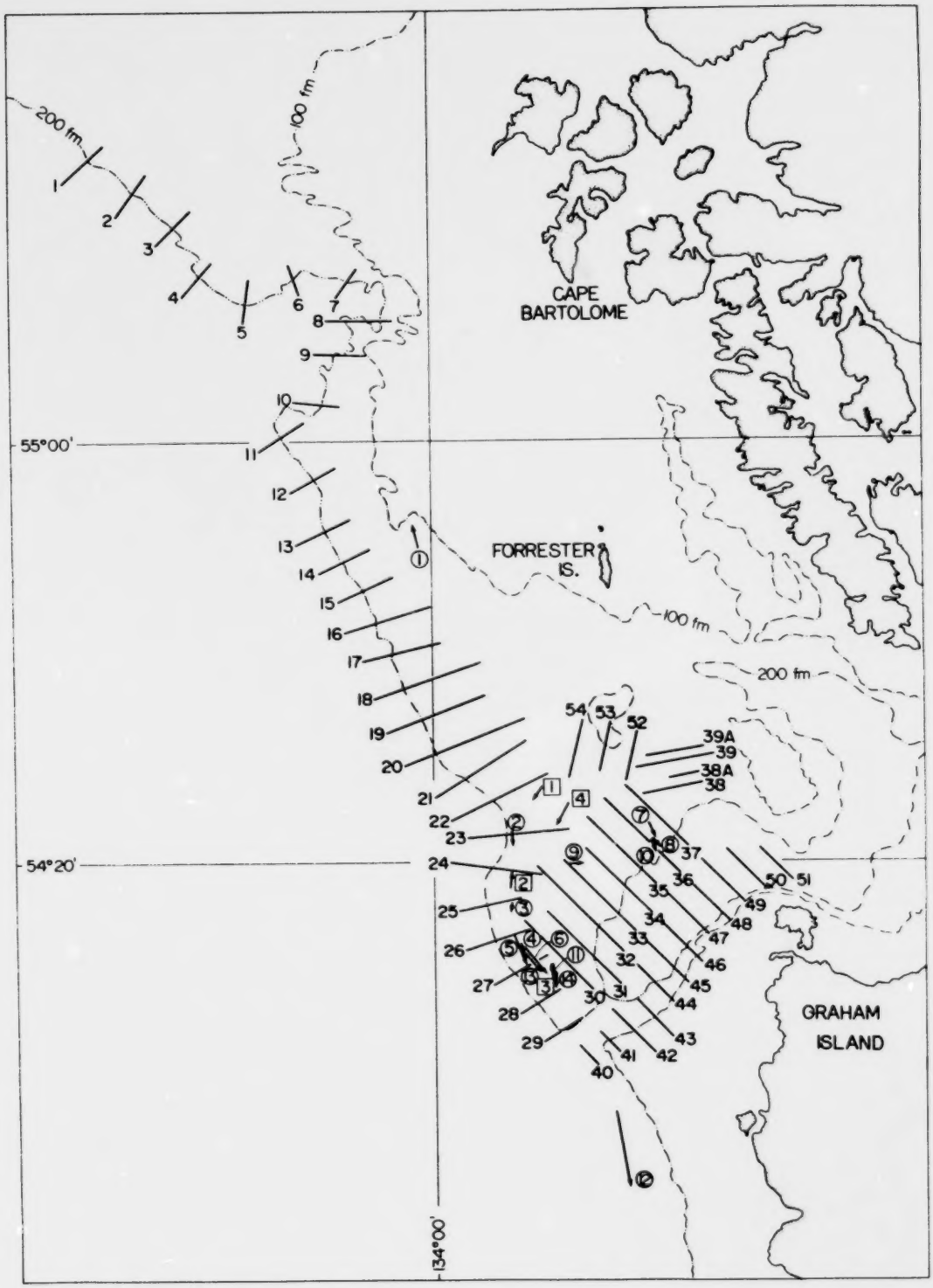


Fig. 1. Survey area with tracklines and haul locations, July 1983. FREE ENTERPRISE NO. 1, hauls are designated with circles and G.B. REED hauls with squares.

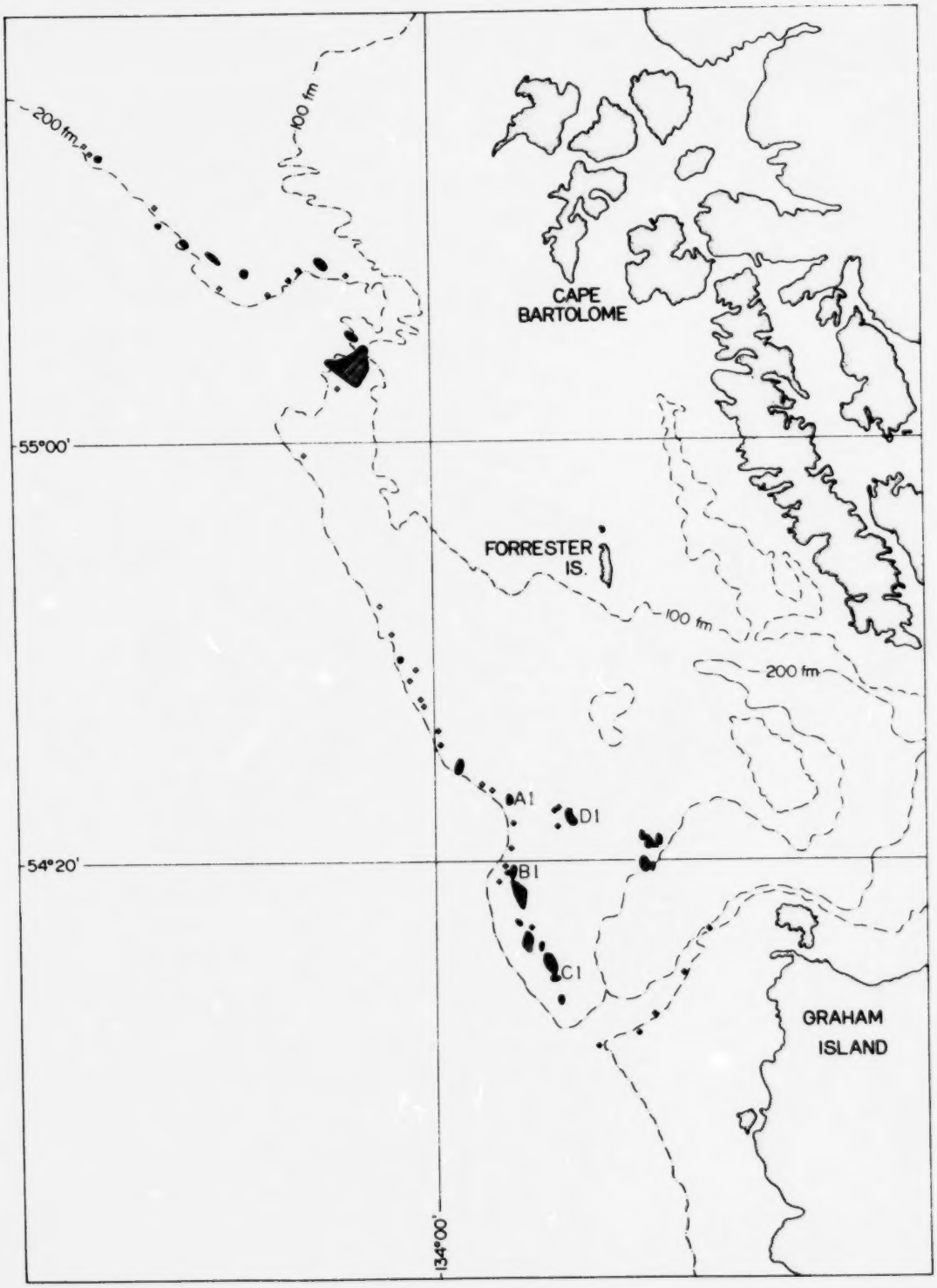


Fig. 2. Rockfish schools encountered by the G.B. REED, July 1983. Unsampled schools are cross-hatched, sampled schools are stippled. Crosses represent schools too small for area estimation.

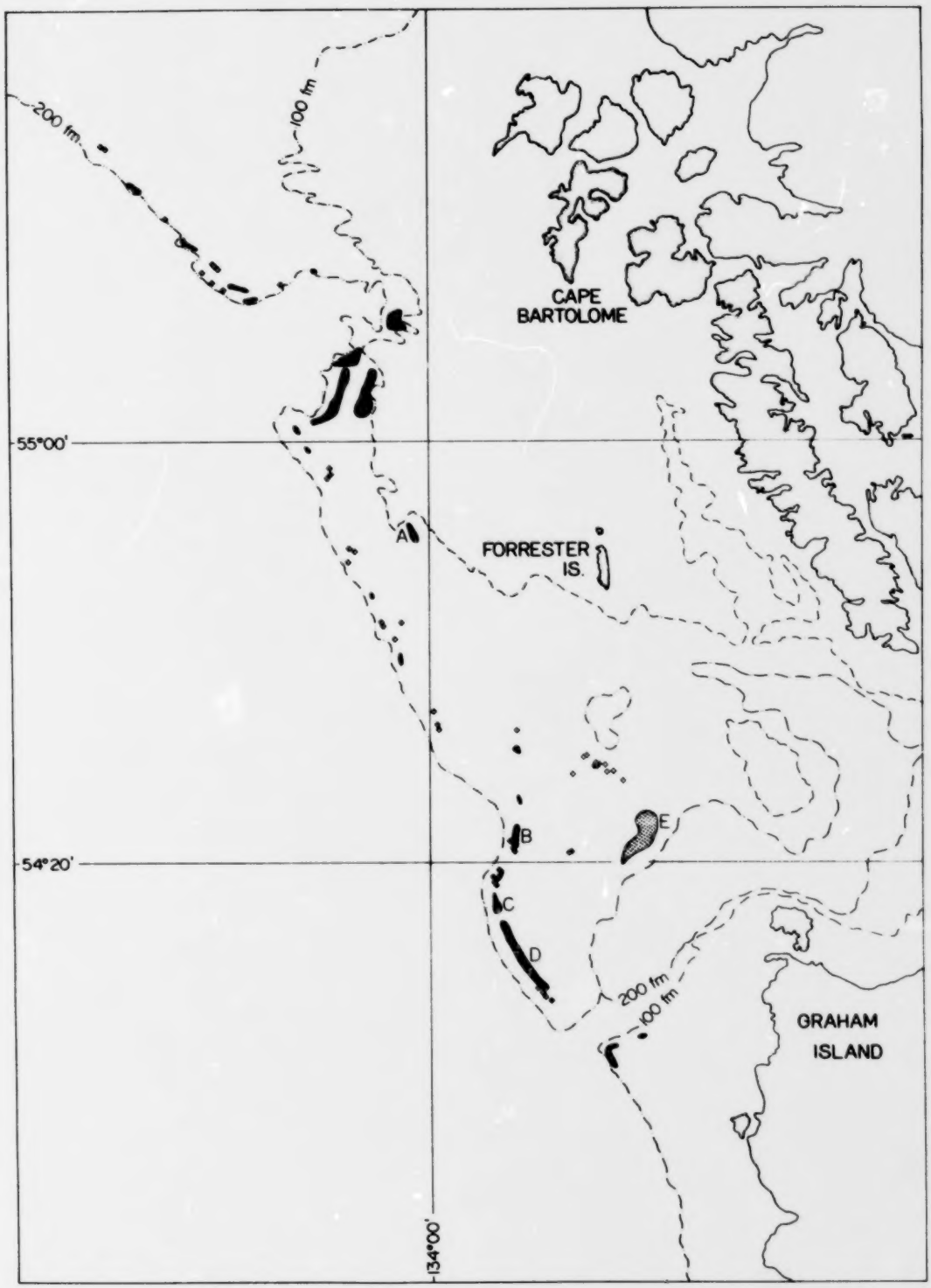


Fig. 3. Rockfish schools encountered by the FREE ENTERPRISE NO. 1, July 1983. Unsampled schools are cross-hatched, sampled schools are stippled. Crosses represent schools too small for area estimation.

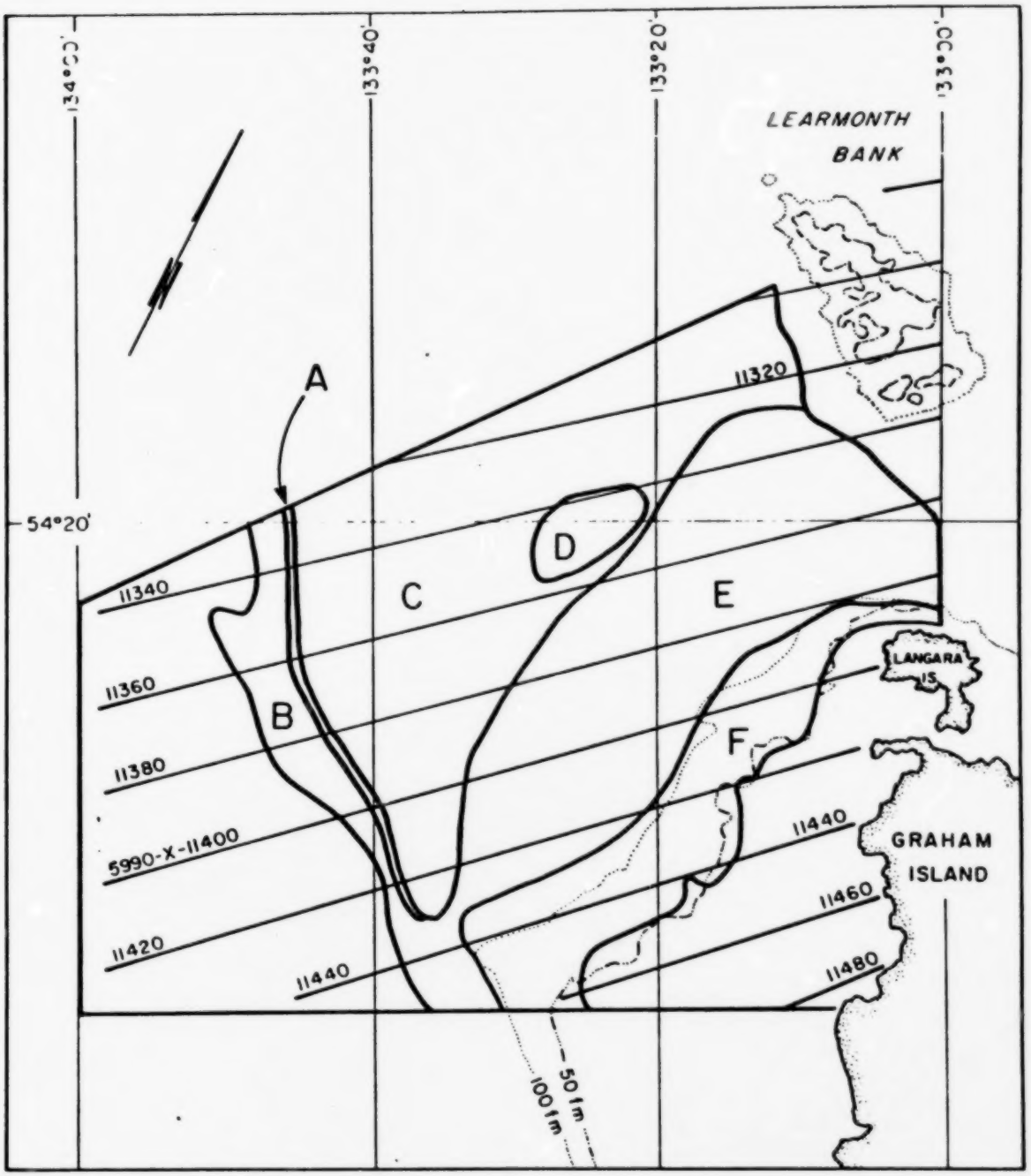


Fig. 4. West Langara survey area showing the subareas A-F (from Lapi and Richards 1981).

Appendix table 1. Vessel specifications for the R/V G.B. REED.

LENGTH:	53.9 m (177 ft)
GROSS TONNAGE:	750
HORSEPOWER:	1000 BHP
CREW:	25
SOUNDER:	Simrad, Elac (net)
RADIO:	6 (VHF, AM, SSB)
RADAR:	(2) Decca
AUTOPILOT:	Sperry
LORAN:	(2) Internav
TRAWL GEAR:	double
WINCHES:	double
CABLE:	Length 1646 m (900 f), 2.7 cm (1 1/8 in)
	Diameter 2.7 cm (1 1/8 in)

Appendix table 2. Vessel specifications for the M/V FREE ENTERPRISE NO. 1.

SKIPPER: Phil Burgess

LANDING PORT: Prince Rupert

OVERALL LENGTH: 25 m (83 ft)

GROSS TONS: 99.49

CREW (total): 3

APPROX. PAYLOAD: 97 t (214,000 lb)

FISH STORAGE: RSW

ELECTRONIC AIDS:

SOUNDER: Simrad EQ 38

RADIO: (2) Raytheon VHF, (2) SSB Daniels

RADAR: Sitex/Koden

AUTOPILOT: Wagner Mk IV

LORAN: Raytheon Raynav 6000

NET SOUNDER: Furuno FNR 200

TRAWL GEAR: double gear

WINCHES: 2 singles

CABLE: Length: 128 m (700 f), Diameter: 2.22 cm (7/8 in)

NET REEL: (2) standard hydraulic trawl net drums

Appendix table 3. Haul data for North 54 Rockfish Biomass Cruise, R/V G.B. REED, July 5-22, 1983 (See footnotes for explanation of terms).

HAUL NUMBER	1	2	3	4
DATE	Jul 11	Jul 12	Jul 12	Jul 14
AREA (MAJOR,MINOR)	5E,35	5E,35	5E,35	5E,35
START TIME (PST)	12:26	8:24	18:15	13:57
DURATION (MIN)	34	38	29	42
START N. LAT. (DEG)	54	54	54	54
(MIN)	27.2	17.4	8.3	25.6
W. LONG (DEG)	133	133	133	133
(MIN)	42.2	47.5	40.4	38.0
FINISH N. LAT (DEG)	54	54	54	54
(MIN)	26.0	19.0	9.6	23.9
W LONG (DEG)	133	133	133	133
(MIN)	44.0	47.1	40.8	38.6
HAUL DISTANCE (KM)	3.3	3.0	1.7	4.8
(N MI)	1.8	1.6	.9	2.6
DIRECTION (DEG. TRUE)	190	0	337	192
BOTTOM DEPTH (M)	243-232	278-241	283-278	208-216
(FATH)	133-127	152-132	155-152	114-118
MODAL DEPTH (FATH)	-	238	280	208
GEAR TYPE	12	12	12	12
TIDE	flood	ebb	ebb	flood
TOTAL CATCH (KG)	297	3232	2814	232
REMARKS	useable	usebale	useable	useable

Appendix table 3 (cont'd)

HAUL NUMBER	1	2	3	4
DATE	Jul 11	Jul 12	Jul 12	Jul 14
AREA (MAJOR,MINOR)	5E,35	5E,35	5E,35	5E,35
Arrowtooth flounder	-	2	4	-
Other flatfish	-	2	-	-
S. aleutianus	-	-	4	-
S. alutus	7	909	2700	22
S. babcocki	-	1	26	-
S. brevispinis	49	436	5	46
S. entomelas	-	3	4	-
S. helvomaculatus	1	1	1	-
S. proriger	45	350	-	97
S. reedi	14	859	-	5
S. variegatus	1	-	-	-
S. zacentrus	179	663	50	46
Seb. alascanus	1	1	9	-
Other rockfish	-	-	-	-
Pacific cod	-	2	6	-
Sablefish	-	2	1	3
Walleye pollock	-	-	1	-
Other roundfish	-	-	-	-
Ratfish	-	1	1	13
Skates	-	-	2	-
Other selachii	-	-	-	-
Total catch (kg)	297	3232	2814	232

Appendix table 4. Haul data for North 54 Rockfish Biomass Cruise, M/V FREE ENTERPRISE NO. 1, July 8-19, 1983 (See footnotes for explanation of terms).

HAUL NUMBER	1	2	3	4
DATE	Jul 9	Jul 11	Jul 11	Jul 11
AREA (MAJOR,MINOR)	AL,32	5E,35	5E,35	5E,35
START TIME (PST)	20:31	12:10	17:35	21:39
DURATION (MIN)	35	24	10	27
START N. LAT. (DEG)	54	54	54	54
(MIN)	49.8	22.7	15.8	12.1
W. LONG (DEG)	134	133	133	133
(MIN)	2.4	48.8	46.8	45.9
FINISH N. LAT (DEG)	54	54	54	54
(MIN)	51.7	21.5	15.3	10.6
W LONG (DEG)	134	133	133	133
(MIN)	2.7	48.6	47.2	45.1
HAUL DISTANCE (KM)	4.4	1.5	.7	3.2
(N MI)	2.4	.8	.4	1.7
DIRECTION (DEG. TRUE)	288	132	162	157
BOTTOM DEPTH (M)	192-187	243-229	243-243	236-245
(FATH)	105-102	133-125	133-133	129-134
MODAL DEPTH (M)	-	-	-	-
GEAR TYPE	12	12	12	12
TIDE	flood	ebb	flood	slack
TOTAL CATCH (KG)	468	4301	375	7223
REMARKS	useable	useable	useable	useable

Appendix table 4 (cont'd)

HAUL NUMBER	1	2	3	4
DATE	Jul 9	Jul 11	Jul 11	Jul 11
AREA (MAJOR,MINOR)	AL,32	5E,35	5E,35	5E,35
Arrowtooth flounder	29	-	-	-
Other flatfish	-	-	-	-
S. aleutianus	8	-	-	-
S. alutus	-	-	-	-
S. babcocki	58	-	1	-
S. brevispinis	4	105	14	56
S. ciliatus	18	-	-	-
S. entomelas	-	-	-	260
S. flavidus	10	-	-	-
S. helvomaculatus	2	-	-	-
S. pinniger	5	-	-	-
S. proriger	93	-	92	118
S. reedi	12	655	17	-
S. variegatus	-	40	-	-
S. zacentrus	1	1657	79	-
Seb. alascanus	1	-	2	-
Other rockfish	-	-	-	-
Pacific cod	3	-	-	-
Sablefish	21	-	-	-
Walleye pollock	-	-	-	-
Other roundfish	-	-	-	-
Ratfish	-	-	-	-
Spiny dogfish	3	-	-	-
Other selachii	-	-	-	-
Total catch (kg)	468	4301	375	7223

Appendix table 4 (cont'd)

HAUL NUMBER	5	6	7	8
DATE	Jul 12	Jul 12	Jul 13	Jul 14
AREA (MAJOR,MINOR)	5E,35	5E,35	5E,35	5E,35
START TIME (PST)	10:35	12:55	11:12	10:48
DURATION (MIN)	57	60	23	26
START N. LAT. (DEG)	54	54	54	54
(MIN)	12.9	11.6	23.7	21.3
W. LONG (DEG)	133	133	133	133
(MIN)	46.9	45.2	24.6	23.5
FINISH N. LAT (DEG)	54	54	54	54
(MIN)	10.1	9.3	22.3	20.2
W LONG (DEG)	133	133	133	133
(MIN)	44.7	41.7	23.7	22.0
HAUL DISTANCE (KM)	5.9	5.6	3.5	2.6
(N MI)	3.2	3.0	1.9	1.4
DIRECTION (DEG. TRUE)	167	115	157	128
BOTTOM DEPTH (M)	245-240	260-262	287-280	247-249
(FATH)	134-131	142-143	157-153	135-136
MODAL DEPTH (M)	-	-	-	-
GEAR TYPE	12	12	12	12
TIDE	slack	flood	flood	ebb
TOTAL CATCH (KG)	12341	4886	232	583
REMARKS	useable	useable	useable	useable

Appendix table 4 (cont'd)

HAUL NUMBER	5	6	7	8
DATE	Jul 12	Jul 12	Jul 13	Jul 14
AREA (MAJOR,MINOR)	5E,35	5E,35	5E,35	5E,35
Arrowtooth flounder	-	-	4	2
Dover sole	-	-	3	10
Rex sole	-	-	4	3
Other flatfish	-	-	-	-
S. aleutianus	-	-	3	-
S. alutus	11487	4692	193	373
S. babcocki	-	17	-	4
S. brevispinis	63	-	-	10
S. ciliatus	-	-	-	-
S. entomelas	594	40	-	-
S. flavidus	-	-	-	-
S. helvomaculatus	-	-	-	2
S. pinniger	-	-	-	-
S. proriger	158	17	-	-
S. reedi	-	-	-	11
S. variegatus	-	-	-	-
S. zacentrus	39	120	-	11
Seb. alascanus	-	-	15	21
Other rockfish	-	-	-	-
Pacific cod	-	-	-	-
Sablefish	-	-	7	19
Walleye pollock	-	-	3	107
Other roundfish	-	-	-	-
Ratfish	-	-	-	10
Spiny dogfish	-	-	-	-
Other selachii	-	-	-	-
Total	12341	4886	232	583

Appendix table 4 (cont'd)

HAUL NUMBER	9	10	11	12
DATE	Jul 14	Jul 15	Jul 16	Jul 18
AREA (MAJOR,MINOR)	5E,35	5E,35	5E,35	5E,31
START TIME (PST)	20:33	11:05	13:43	10:25
DURATION (MIN)	27	25	70	115
START N. LAT. (DEG)	54	54	54	53
(MIN)	19.8	21.3	12.2	55.9
W. LONG (DEG)	133	133	133	133
(MIN)	38.0	23.3	46.2	30.6
FINISH N. LAT (DEG)	54	54	54	53
(MIN)	19.8	20.1	8.9	48.8
W LONG (DEG)	133	133	133	133
(MIN)	35.8	22.4	42.7	28.2
HAUL DISTANCE (KM)	3.7	3.0	6.3	11.7
(N MI)	2.0	1.6	3.4	6.3
DIRECTION (DEG. TRUE)	62	93	80	132
BOTTOM DEPTH (M)	251-249	252-243	247-258	315-448
(FATH)	137-136	138-133	135-141	172-245
MODAL DEPTH (M)	-	-	-	-
GEAR TYPE	12	12	12	12
TIDE	ebb	ebb	slack	flood
TOTAL CATCH (KG)	830	479	7074	2
REMARKS	useable	useable	useable	useable

Appendix table 4 (cont'd)

HAUL NUMBER	9	10	11	12
DATE	Jul 14	Jul 15	Jul 16	Jul 18
AREA (MAJOR,MINOR)	5E,35	5E,35	5E,35	5E,31
Arrowtooth flounder	2	4	-	-
Dover sole	7	1	-	-
Rex sole	2	1	-	-
Other flatfish	-	-	-	-
S. aleutianus	-	-	-	-
S. alutus	261	376	6774	-
S. babcocki	-	3	24	-
S. brevispinis	507	5	-	-
S. ciliatus	2	-	19	-
S. entomelas	-	3	-	-
S. flavidus	-	-	-	-
S. helvomaculatus	-	-	-	-
S. pinniger	-	-	-	-
S. proriger	28	-	24	-
S. reedi	-	9	-	-
S. variegatus	-	-	-	-
S. zacentrus	21	30	233	-
Seb. alascanus	-	12	-	-
Other rockfish	-	-	-	-
Pacific cod	-	1	-	-
Sablefish	-	12	-	-
Walleye pollock	-	21	-	2
Other roundfish	-	-	-	-
Ratfish	-	1	-	-
Spiny dogfish	-	-	-	-
Other selachii	-	-	-	-
Total	830	479	7074	2

Appendix table 4 (cont'd)

HAUL NUMBER	13	14
DATE	Jul 19	Jul 19
AREA (MAJOR,MINOR)	5E,35	5E,35
START TIME (PST)	8:10	10:52
DURATION (MIN)	60	21
START N. LAT. (DEG)	54	54
(MIN)	12.0	8.1
W. LONG (DEG)	133	133
(MIN)	46.3	40.3
FINISH N. LAT (DEG)	54	54
(MIN)	9.5	9.1
W LONG (DEG)	133	133
(MIN)	42.9	40.0
HAUL DISTANCE (KM)	5.4	1.5
(N MI)	2.9	.8
DIRECTION (DEG. TRUE)	63	302
BOTTOM DEPTH (M)	263-241	291-282
(FATH)	144-132	159-154
MODAL DEPTH (M)	-	-
GEAR TYPE	12	12
TIDE	flood	flood
TOTAL CATCH (KG)	6024	894
REMARKS	useable	useable

Appendix table 4 (cont'd)

HAUL NUMBER	13	14
DATE	Jul 19	Jul 19
AREA (MAJOR,MINOR)	5E,35	5E,35
Arrowtooth flounder	-	-
Dover sole	17	-
Rex sole	-	3
Other flatfish	-	-
S. aleutianus	-	-
S. alutus	5720	847
S. babcocki	-	-
S. brevispinis	116	14
S. ciliatus	-	-
S. entomelas	-	3
S. flavidus	-	-
S. helvomaculatus	-	-
S. pinniger	-	-
S. proriger	-	3
S. reedi	-	-
S. variegatus	-	3
S. zacentrus	84	14
Seb. alascanus	21	7
Other rockfish	-	-
Pacific cod	66	-
Sablefish	-	-
Walleye pollock	-	-
Other roundfish	-	-
Ratfish	-	-
Spiny dogfish	-	-
Other selachii	-	-
Total	6024	894

Footnotes to Appendix tables 3 and 4.

AREA: 5E - west coast of the Queen Charlotte Islands (north of 54°N latitude)
AL - southeastern Alaska

START TIME: Pacific daylight saving time

DEPTH (meters): Depth at beginning and end of haul

GEAR TYPE: See Appendix tables for net specifications

TOTAL CATCH: Recorded in kilograms. Asterisk denotes estimate

OTHER FLATFISH: Dover sole (Microstomus pacificus); petrale sole (Eopsetta jordani); rex sole (Glyptocephalus zachirus)

OTHER ROCKFISH: Dusky rockfish (Sebastes ciliatus)

OTHER SELACHII: Longnose skate (Raja rhina)

For scientific and common names of species caught, refer to Appendix table 5.

Appendix table 5. Common and scientific names of species.

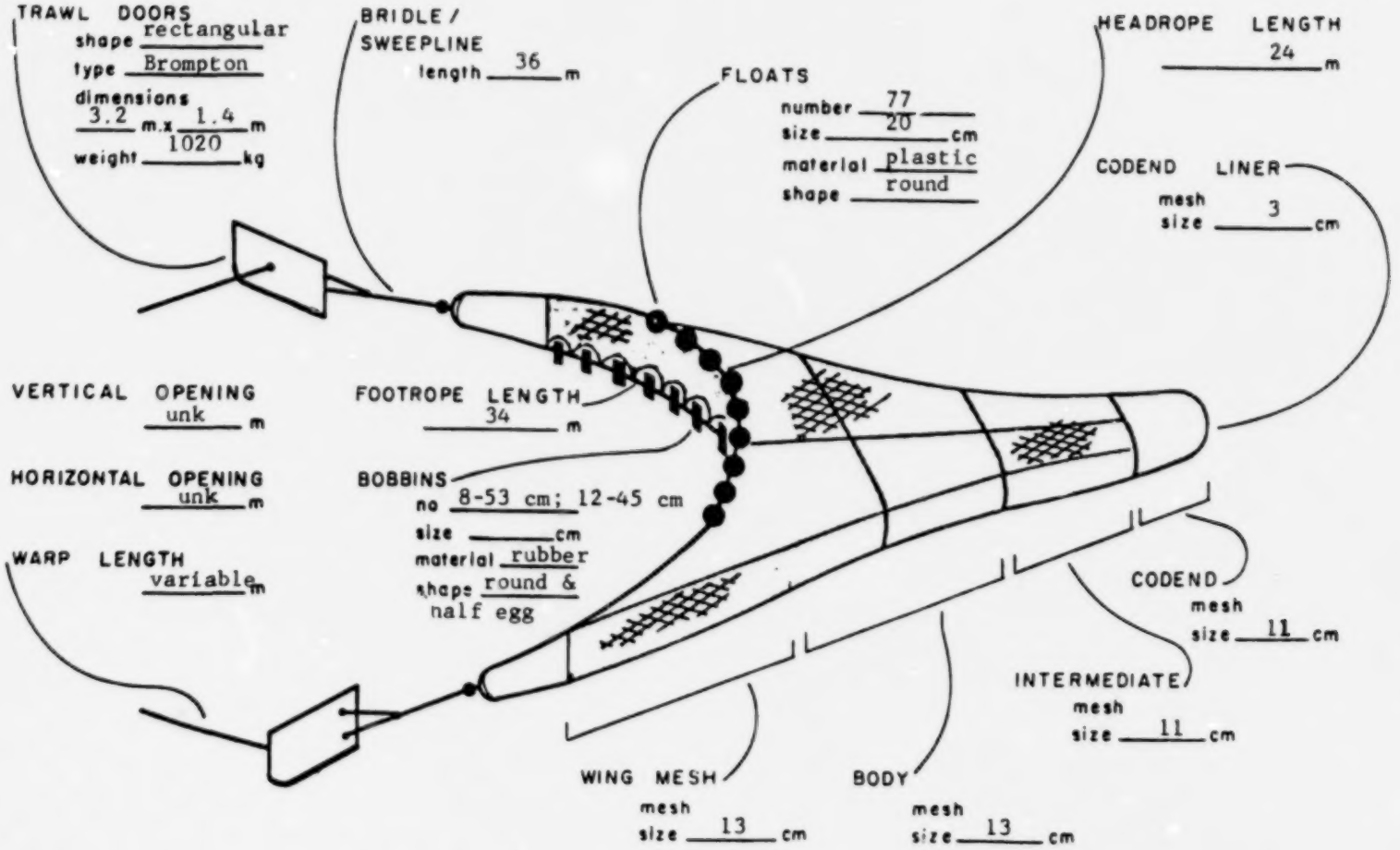
Common name	Scientific name
FLATFISH	
Arrowtooth flounder	*Atheresthes stomias*
Dover sole	*Microstomus pacificus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
ROUNDFISH	
Rougheye rockfish	*Sebastes aleutianus*
Pacific ocean perch	*S. alutus*
Redbanded rockfish	*S. babcocki*
Silvergray rockfish	*S. brevispinis*
Widow rockfish	*S. entomelas*
Yellowtail rockfish	*S. flavidus*
Rosethorn rockfish	*S. helvomaculatus*
Canary rockfish	*S. pinniger*
Redstripe rockfish	*S. proriger*
Yellowmouth rockfish	*S. reedi*
Sharpchin rockfish	*S. zacentrus*
Shortspine thornyhead	*Sebastolobus alascanus*
Pacific cod	*Gadus macrocephalus*
Sablefish	*Anoplopoma fimbria*
Walleye pollock	*Theragra chalcogramma*
SELACHII	
Ratfish	*Hydrolagus colliei*
Dogfish	*Squalus acanthias*
Skate	*Raja* spp.

Appendix fig. 1.

NET DIMENSIONS AND CHARACTERISTICS FOR BOTTOM TRAWL

VESSEL G.B. Reed NET Atlantic Western III

OBSERVATION PERIOD July 5-22, 1983



Appendix fig. 2.

NET DIMENSIONS AND CHARACTERISTICS FOR BOTTOM TRAWL

VESSEL FREE ENTERPRISE NO. 1 NET Atlantic Western IIIa

OBSERVATION PERIOD July 5-22, 1983